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**ORGANIZATION CHARACTERISTICS: CAN THEY INFLUENCE THE
CONSTRUCTION INNOVATION?****¹Ng Weng Seng, ²Norlena Hasnan, & ³Shahimi Mohtar**¹NWS Cost Engineering Consult^{2,3}Universiti Utara Malaysia Kuala LumpurCorresponding author: nws.cost.engr@gmail.com

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ABSTRACT

Heavy constructions are increasingly becoming more complicated, demanding increased innovative methods, and greater technological advancement. The complexity of the industry, generally has been described as multi-faceted and highly fragmented with significant problems such as communication breakdown, conflicts, and disputes. The lack of organization characteristics can apparently limit the effort of the construction industries to adopt the technology and innovation. Hence, this paper aims to investigate to the influence of organization characteristics namely construction type, presence of trade unions, and professional and trade association affiliation towards the construction innovation. In order to achieve the research objectives, mail surveys have been conducted among the construction companies in Malaysia. A total of 703 questionnaire surveys were mailed to randomly selected construction companies that operating in Malaysia and registered as G7 contractor with CIDB. The number of returned usable surveys totaled 383, yielding an effective response rate of 54.4%. All the organizational characteristics proposed have been found to be positively correlated with construction innovation. Apart from suggesting the direction of future construction industry study, this paper is valuable in providing insights for the contractors in implementing innovative construction technologies that can be used to devise strategic marketing plans and ultimately for enjoyment of competitive advantages.

Keywords: *Innovation, construction, organization characteristics, Malaysia*

INTRODUCTION

As Malaysia progressively marches towards developed and high income country, the role of the building industry is greatly enhanced, with the idea of transforming the aspirations and needs of people into reality. Hence, it is an urgent need for the construction industry to search on productive ways to improve performance. Construction is an unique environment, multiplayers and multi levels, which formed it to be as a creative and innovative industry. No single projects is the same as another and that diversity breeds creative and innovative problem solving at the practical level. The concept of innovation has always been debatable and defined subjectively by the stakeholders. As described by Rogers (1995), innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. Innovation offers a huge range of methods and technologies for the contractors to adopt in their projects. Mention (2011) claimed innovation as “an interactive process between the firm and its environment, as the result of the collaboration between a wide variety of actors, located both inside and outside the firm.” However, dealing with the dynamic nature of the construction industry itself, the rapid influx of the new technologies and plus the pressures from social, economic and political factors, the decisions as to how and to what extend the construction should be innovative are no longer trivial. Demands from the stakeholders keep changing which required the companies to search for the best and effective innovative technological construction materials and methods that will improved the way the built environment is designed, built and maintained.

Construction involves producing unique and diverse projects on site and services examples design, surveying and consulting. Therefore, much of construction innovation is co-developed at the project level (Ozorhon 2013). At this project level, the measurement of innovation can be complicated as there is no consensus on a set of variables either from the input or output perspectives (Ozorhon *et. al.*, 2016). In addition, the organizations’ innovativeness in construction industry has virtually been given relatively less attention and neglected as a viable area for investigation (Holt, 2010). The complexity of the industry, generally has been described as multi-faceted and highly fragmented with significant problems such as low productivity, cost and time overrun, communication breakdown, conflicts and disputes. These characteristics can apparently limit the effort of the construction industries to adopt the technology and innovation (Steward & Mohamed, 2003).

Previous studies have discussed on innovation diffusion in construction industry (e.g., Taylor and Levitt 2004; Kale and Ardit 2005, 2010). There are numerous factors that lead companies to invest in innovation which can be categorized from the perspective of project, organization, and industry (Ozorhon & Oral, 2016). Although the topics concerning factors that influence construction innovation have been previously explored, yet these studies were context specific, their implementation and implication are usually limited to countries, and the operating environment where these studies were conducted (Toor and Ogunlana, 2009).

There is a lack of effort to contextualize the findings into local context where the organizations characteristics are different. Hence, this paper aims to investigate the influence of organization characteristics of the constructions companies namely construction type, presence of trade unions, and professional and trade association affiliation towards the construction innovation.

LITERATURE REVIEW

Innovation in Construction Industry

Historically, publication in construction innovation has started from the contribution of Tatum (from 1986 onward) with the focus on the products and construction technologies. Later, the attention has since shifted to processes and organizational change (Gann 2003). Nevertheless, the innovativeness of construction industry has always been debatable. Yet, many had generally agreed to measure innovation in terms of input and output at the construction project level (Archibugi and Pianta, 1996, Brockmann, Brezinski and Erbe, 2016, Ozorhon & Oral, 2016). According to Blayse and Manley (2004), the higher level of innovation in construction industry can lead to a higher economic growth. In the same line, Brockmann, Brezinski and Erbe (2016) claimed innovation in construction can be regarded as changes leading to an improvement of input–output relationship in the products and processes as well as within the technical, management, or legal organization of a project that can be evaluated monetarily. The innovation in construction can only be achieved if management understands client requirements and collaboration throughout the whole project life cycle (Aouad, Ozorhon & Abbott, 2010).

According to Seng, Kumar, and Shahimi (2012), the rate of technological innovation in construction sector is needed to ensure sustainability and gain competitive advantages. They added that the heavy-constructions have increased to be more complex, demanding, and greater technological advancement in their activity. Most of owners are starting to be focusing on quality or value for their investment. Hence, it is critical for the construction companies to have the organizational and technological support to manage the complex processes in a project and effectively collaborate with the stakeholders (Erqan, 2019)

Several studies for instance Aouad, Ozorhon and Abbott (2010) and Ozorhon & Oral, 2016, addressed the importance to explore and understand the mechanism that drive innovation in construction. They mention that, although the construction industry has always been among the driving forces of the economy but it is always criticized because of lack of efficiency and unwillingness to innovate compare to other industries. Kulatunga et al. (2011) highlighted that the construction organization need to involve in innovative practices because most of the clients have innovative thinking. Hence, this adds the pressure for the construction organizations to improve their level of innovation if they want to build long-term relationship, take advantage from other participants and create the new innovative contract agreement with clients. In this current study, innovation is defined as a new idea, new design, material, technology, component or construction method deployed in a project. Being innovative, the construction

organizations, may be rewarded with potential additional benefits but might also be associated with potential risks (Ling, 2003, Emiliya, Rodney and Stewart, 2015).

Organization Characteristic

Type of Construction

Goldberg and Shepard (1989) indicate that the type of construction that a firm is involved in can be a determinant of innovation in the construction industry. Innovation implementation and adoption may be more relevant to certain types of construction. Kuczmarki and Jeff (2009) specifically hypothesize that innovation implementation and adoption will be more prevalent among construction firms that are predominantly engaged in complicated construction design in relative to conventional construction. Their regression analysis indicates that the coefficient of their construction type parameter is significant associated with their measure of innovativeness. Advanced contemporary designs are typically more structurally complex, require more capital intensive equipment, and regulated to a greater degree by building codes than conventional designs. As a result, there is differential potential for innovation implementation and adoption within each of these market subsectors. Similarly, Ozorhon (2010) and Ellis, Dulaimi, Gorse (2019) acknowledged the complexities inherent in the whole process of different types of construction projects will add on the difficulty in measuring innovation. Nevertheless, study by Emmitt (2016) found out contemporary design particularly supported by information communication technology (ICT) and building information modelling (BIM) has a positive trend which enabled the construction design managers to perform work more efficient and shifted their role from reactive to be more proactive. With this pro-active stance, the evolving trend of types of construction design and information, therefore, can potentially offers the innovativeness in the construction to be exclusively adopted.

Hence, it is hypothesized in this study that construction firms engaged predominantly in conventional construction designs will be significantly less innovative than firms predominantly engaged in contemporary construction designs. In addition, the type of projects particularly that involved in the high-tech projects and adoption of latest technologies seem to have an effect on the construction innovation performance. Stated formally, it is hypothesized that:

H1 Type of construction has a positive relationship with construction innovation.

Presence of Trade Unions

A potentially important characteristic that can significantly influence the firm's decision is the presence of trade union (Stuart, 2011). Naturally, this leads to the question on how do trade unions influence the adoption activity and innovativeness of construction firms. Several studies examine the influence that unions have on the implementation and adoption of various innovative products and process technologies across firms and industries using competing economic and industrial relations theories to develop

hypotheses (Betcherman, 1991; Keefe, 1991; Latreille, 1992). The trade union strategy in construction industry is mainly to address the fragmentation of the supply chain and helps to minimize the workforce problems from the result of fragmentation such as employer, employment status, working conditions and nationality (Keune & Pedaci (2019). Although the trade union plays an important role in shaping the working environment, the effect may have negative and positive towards innovation activities and adoption (Cabaleiro & Gutiérrez, 2019)

According to David (2008), the presence of trade unions in construction is a direct outcome of advancing technology and occupational specialization during the industrial revolution. Barriers were set in place between differing construction trades, not necessarily to develop monopolistic practices among the trades, but to develop guarantees that each of the individual trades utilized in the construction of a structure would be completed with competence. Therefore, the hypothesis is formulated as follow:

H2 Presence of trade union has a positive relationship with construction innovation.

Professional and Trade Association Affiliations

The international industrial business environment in the past decade has seen an increasing shift from large, vertically integrated firms, which generally emphasize the production of output and the elimination of competitors, toward smaller, decentralized firms that stress implementation and adaption in collaboration with other firms (Hakansson, 1989; Stuart, 2011). This collaboration even occurs among firms directly competing with one another in the same industrial sectors.

While several forms of inter-organizational networks exist, this study attempts to examine the specific role that professional and trade associations have on construction firms' innovativeness with regard to construction technologies implementation and adoption. A link between professional and trade associations and firms' innovativeness has been suggested for quite some time within the industrial organization and industrial history literature (Tocqueville, 1961). Fierro (2011) indicates that most associations evolved into industry mouthpieces, promoting new ideas and lobbying for the protection of important interests. Carter and Williams (1957), and Stuart (2011) are even more specific in defining the role of professional and trade associations, stating that a primary function of the association is the promotion of research and the spreading of technical knowledge.

There has been some suggestion within the literature that the chief value of associations, in the long run, has been for the support of the smaller firm (Johannisson, 1990; Obloj & Davis, 1991 and Stuart, 2011). Hardie (2010) indicates that the small firm generally has neither the slack resources nor the capital to make rapid technological progress relative to larger firms. Gras (1986) states the small firm is commonly a single individual or partners with a few workers and constitutes on the whole a large segment of middle-class society. Carter and Williams (1957), and Stuart (2011) make a similar argument, indicating that small firms lack economies of scale and scope and have a difficult time digesting new

research and technologies. Fierro (2011) examines the nature of firm membership in trade associations between small and large manufacturers. The results of this study indicate that membership in trade associations is more concentrated among larger firms. Furthermore, larger firms are found to be members of a greater number of trade associations relative to smaller firms. Based on the preceding arguments, it is hypothesized that there are positive effect of professional and trade associations on construction firms' innovativeness with regard to construction technologies. Hence:

H3 Professional and trade association has a positive relationship with construction innovation.

RESEARCH METHODOLOGY

A mail survey has been conducted among the construction companies in Malaysia. A total of 703 questionnaire surveys were mailed to randomly selected contraction companies that operating in Malaysia and registered as G7 contractor with CIDB. The number of returned usable surveys totaled 383, yielding an effective response rate of 54.4%. This response rate was significantly greater than other recent survey where the mail survey respond rate in Malaysia is approximately 25% (Ismail and King, 2007).

RESULTS

Survey responses are relying on voluntary participation, and there is always the possibility that respondents and non-respondents differ in some significant manner (Matteson *et al.*, 1984). Therefore, the difficulty associated with the identification on non-respondent's characteristics in anonymous researches is counterpart by an alternative test of non-response bias test. Non-respondents were assumed to have similar characteristics to late respondents (Armstrong & Overton, 1977). However, the initial and follow-up mailings were gathered within the very close timing difference of only one month, and have exceeded the samples size requirements of 281, therefore, it can be concluded that no issues of non-response bias affected the generalizability of the findings of this study and no non-response bias test was required.

Profile of the Respondents

The descriptive statistics in this section are divided into four sections. The responding companies are demographically profiled in this section. The respondents were companies registered with CIDB as G7 contractors. The questionnaires were addressed to the organization leaders of company randomly selected from the list of contractors G7 registered with CIDB. Therefore, accurate insights of the companies' innovativeness could be gathered in more reflective way based on their level of position in the companies. The level of position and companies categories of registration is shown in Figure 1. The majority of the respondents were senior management with record of 53.50%, followed by senior executive with record of 34.20% and executive with record of 10.40%. It is a very good indication that the responses are accurate as the person in

this level of managerial post has contributing to a total of 98.2% and they would be in the best position to know and affect the companies' needs in innovation, With regards to the companies' category of registration, 35.50% of the respondents were registered for all categories of construction, which included building construction, civil engineering construction and mechanical & electrical construction. Meanwhile, the smallest proportion was only 3.1%, from registered as mechanical and electrical contractor only.

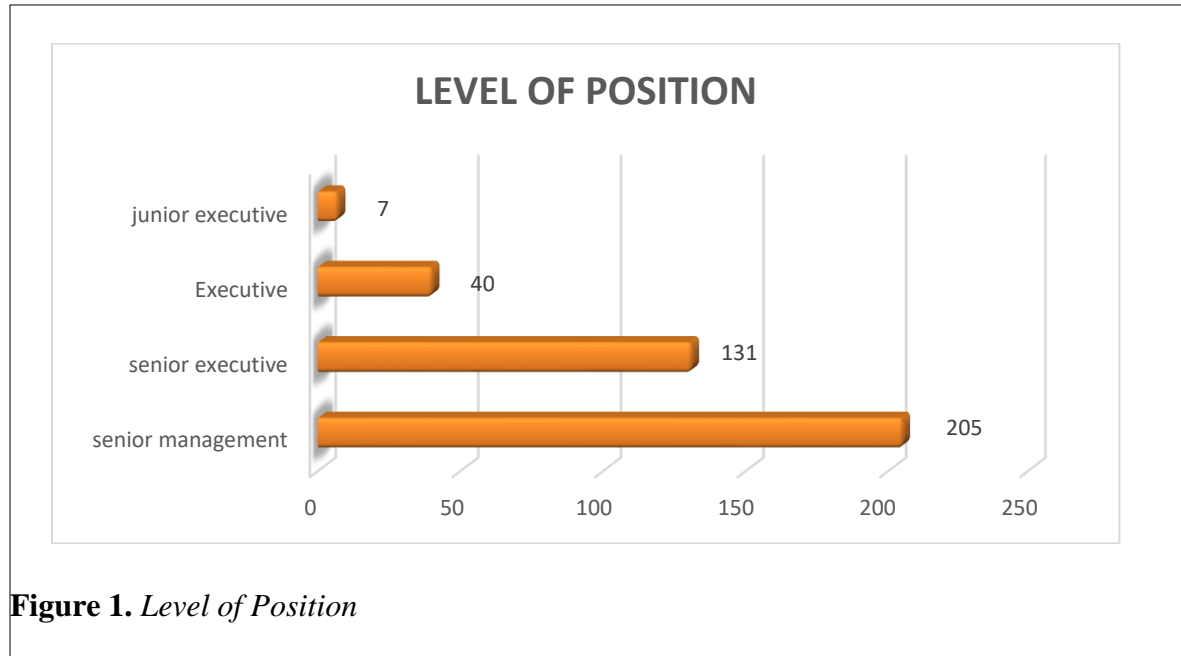


Figure 1. *Level of Position*

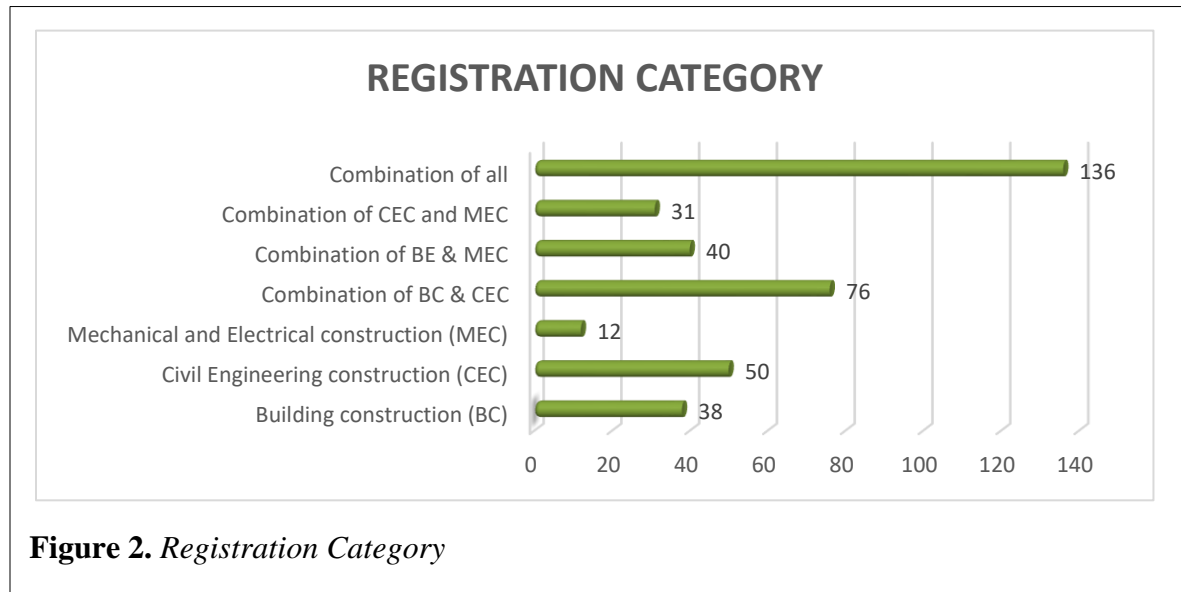


Figure 2. *Registration Category*

Descriptive Analysis

In the descriptive analysis, the means and standard deviation for the interval-scaled variables were derived. The independent variables included the type of construction, presence of trade unions and professional and trade association affiliations in the construction industry. Meanwhile, the degree of innovation implementation and adoption was considered as the dependent variables. Descriptive statistics for the final list of variables of the study are shown in Table 1 and the scale measurements used is a seven point Likert scale. For ease of interpretation, the range of seven point Likert-scales was categorized into equal sized categories of low, moderate and high. Therefore, score of less than 2.33 [4/3+lowest value (1)] is considered as low; scores of 5.67 [highest value (7)-4/3] is considered high and those in between considered moderate. The analysis shown that all scores are moderate, consistent in nature and there were no explicit scores being categorized as low or high. This shown that all the respondents are generally having moderate perception on innovation implementation and adoption behavior.

Table 1

Summary of Cronbach's Alpha

VARIABLES	Cronbach's Alpha	Internal Consistency
Organisation and Task Characteristic		
Type of Construction	0.901	Excellent
Presence of Trade Unions	0.803	Good
Profesionaland Trade Union Affiliation	0.890	Good
Construction Firms' innovativeness		
Innovation Implementation	0.886	Good
Overall	0.965	Excellent

Table 2 presents the mean analysis on the details of type of construction. The results showed that generally agreed that issues related type of construction namely the construction design, high technology projects and latest technologies adoption may have positive impact towards the construction innovation.

Table 2

Type of construction

Issues related to type of construction	Mean	Standard Deviation
The contemporary designs required relatively more adoption of new construction technologies	4.63	1.466
The high-tech projects encourage extensive adoption of new construction technologies and construction methods to ease the construction processes and to accomplishment the project goal.	4.61	1.549
The adoption of latest type of construction technologies based on type of construction is to ensure competitive possibly advantages.	4.55	1.569

The presence of trade unions as indicated by previous literature has influenced the construction company's decisions and management approach. Therefore, this study addressed the role of trade unions as shown in Table 3.

Table 3.

The role of trade unions

The Role of Trade Unions	Mean	Standard Deviation
Involvement and participation in professional and/or trades union association affect the adoption of new technologies	4.80	1.507
The trade unions use their monopoly power to seek higher levels of wages and benefits, thereby providing employer incentives to substitute labor-saving technology for relatively expensive union labor.	4.56	1.546
The unions have used negotiations of adjustments to protect employment security and to prevent downgrading after management has made a decision to introduce new technology	4.62	1.379

Other than the presence of trade unions, the study also interested to understand the role of professional and trade association affiliations towards the company decision in adopting the construction innovation. Therefore, respondents were asked questions as shown in Table 4. The result indicated that the respondents have slightly agreed that the professional and trade association affiliations can have some effects on enhancing the company innovativeness.

Table 4

The professional and trade association affiliations

Professional and Trade Association Affiliations	Mean	Standard Deviation
The training provided from the affiliations to the employees affects the company innovativeness in construction technologies	4.94	1.480
The inter-organizational networks allow organizations to exchange both knowledge and resources so as to encourage innovation.	4.57	1.767
The participation in professional and trades union activities assure effective means of higher innovation implementation and adoption level of a company.	4.58	1.696

Correlation Analysis

In order to answer the research question, which addressed the relationship between the organizations characteristics determinants on innovation implementation in construction, Pearson's correlation analysis were conducted. Cohen (1988) suggested that if r score is below 0.50, the correlation between the two variables are considered weak. Referring to Table 5, all independent variables namely construction type, presence of trade union, and professional and trade association have been found to be positively correlated with construction innovation. However, these relationship strength are considered as weak. Therefore, all three hypotheses, H1, H2, and H3 are supported.

Table 5.

Pearson's Correlation between the variables

	CI
Construction Innovation	1
Construction Type	.150**
Presence of trade union	.169**
Professional and trade association	.146**

***.* Correlation is significant at the 0.01 level (2-tailed).

**.* Correlation is significant at the 0.05 level (2-tailed)

DISCUSSION AND CONCLUSION

This research aims to investigate whether factors in the organization characteristics can influence the construction innovation within Malaysian construction industry. Findings show that all variables namely types of construction, presence of trade union, and professional and trade association affiliation, are positively correlated with construction innovation. Nevertheless, their associations were considered weak. The literature review reveals innovation as, to challenge the current paradigms and this form the basis to look, accepted logic and seek changes. As indicated by Thomson, Wallace and Sederblad (1994), although the work practices are highly relies on the existence of the trade unions, yet the challenges will be the organization's capacity to disentangle the elements and the balance the threats and opportunities of innovation. They further claimed, in their study comparing the British and Swedish trade unions, the British activists tended to stereotype those innovations in workplace as in a negative way especially in the era of 70-80s. Consequently many activists have little understanding of the complexities involved. Whereas, Swedish trade union movement is known for its explicit and progressive policies. The Swedish model of industrial relations was formalized that enabled co-operative industrial relations on central as well as local levels. The unions had largely uncritical attitude to work organization issues and supported the introduction of innovation. In line with the Thomson, Wallace and Sederblad's study, others also

suggested that the presence of a union "voice" can promote the organizational changes related to increasing the rate of innovation diffusion (Keefe, 1991; Stuart, 2011)

In addition, this study highlights the needs for professional and trade association affiliation to enhance to construction innovation. Given today's trend toward collaboration between competing firms, one would expect that the role of inter-organizational networks, can be viewed as significant mechanisms that facilitate the horizontal and vertical interactions among a set of organizations, is becoming increasingly important (Swan & Newell, 1995; Stuart, 2011), thus, facilitates the efforts towards innovation.

This research is valuable in providing insights to contractors in implementing innovative construction technologies that can be used to devise strategic marketing plans and ultimately for enjoyment of competitive advantages. The findings of the research suggest to specify organization characteristic such as presence of trade union, and professional and trade association affiliation. From the theoretical perspective, this study develops a model of construction firms' innovativeness that utilizes a dependent variable measure that is unique when compared to past innovation studies. As a result, this innovation study more closely reflects the essence of the major innovation implementation and adoption process model developed within the business literature. The findings may also provide insight on the direction of future research in the areas of innovation in the Malaysian construction industry sector.

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